PRC Docket No. N2006-1

USPS Library Reference N2006-1/9

Evolutionary Network Development
Technical Conference Presentation Slides

On April 28, 2006, the United States Postal Service presented an informal, off-the-record description of the Evolutionary Network Development optimization and simulations models and some simulation model outputs related to the Bridgeport CT AMP decision reflected in USPS Library Reference N2006-1/5.

This Library Reference consists of copies of the presentation slides that formed the basis for the Postal Service's presentation.

EVOLUTIONARY NETWORK DEVELOPMENT SERVICE CHANGES, 2006
Docket No. N2006–1

Technical Conference

April 28, 2006

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Agenda

1. Modeling Approach
2. Distribution Concept
3. Optimization & Simulation Models
4. Core Data Requirements

1. Modeling Approach

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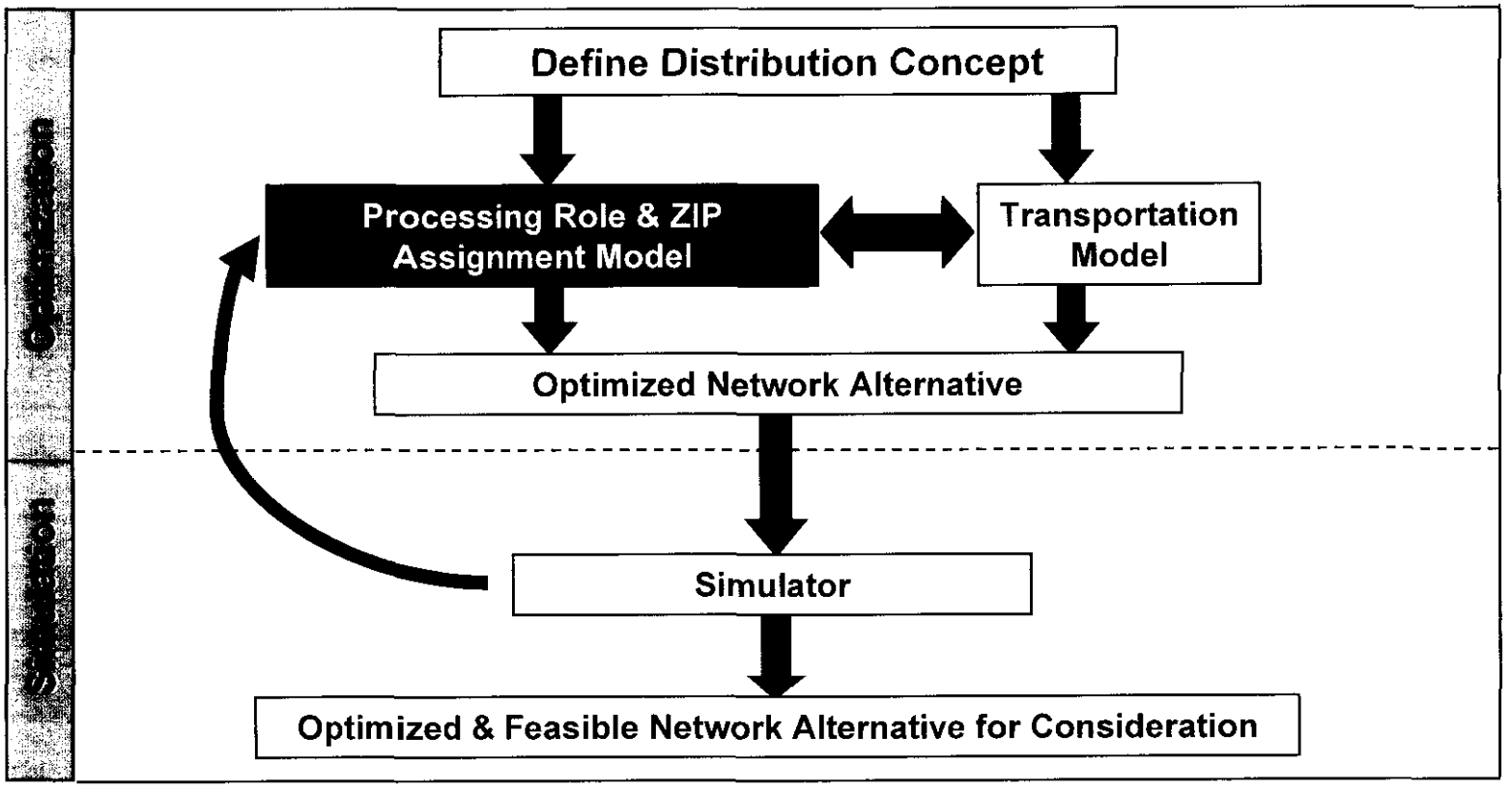
Modeling Approach

- **The analysis of one scenario within END requires a predefined Distribution Concept and the interaction of several different models**



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2. Distribution Concept

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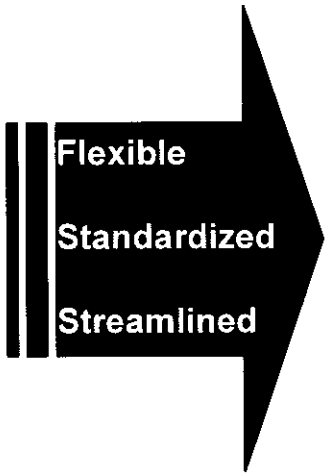
Network Simplification

Current Network

- P&DCs
- CSFs
- BMCs
- L&DCs
- Annexes
- HASPs
- AMCs
- RECs
- ISCs



Future Network

- Regional Distribution Centers (RDC)
- Local Processing Centers (LPC)
- Destination Processing Centers (DPC)
- Airport Transfer Centers (ATC)
- Remote Encoding Centers (REC)

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RDC Concept – Facility Roles

- **Regional Distribution Center (RDC)**
  - Package and bundles of magazines processing (all classes)
  - Surface Transfer Center (STC)
- **Local Processing Center (LPC)**
  - Origin and Destination processing of individual letters and magazine/catalogs
- **Destination Processing Center (DPC)**
  - Destination processing of individual letters and magazine/catalogs
- **Destination Delivery Unit (DDU)**
- **Mailer Entry at each location**

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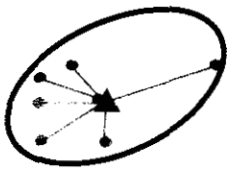
Snapshot of a Generic LPC/DPC

- **3 digit ZIPs are mapped to Local Processing Centers & Destination Processing Centers (LPC/DPC)**
- **This grouping becomes an LPC/DPC family**



Legend:

▲ LPC/DPC

● 3-Digit ZIP Code

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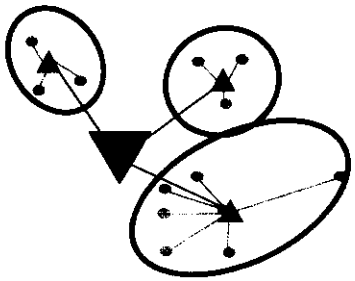
Snapshot of a Generic RDC

- **Several LPC/DPC families are mapped to a Regional Distribution Center (RDC)**
- **Transportation within this Processing Family is structured just like a hub and spoke, with all transports going to and from the RDC**



Legend: ▲ LPC/DPC ● 3-Digit ZIP Code ▼ RDC

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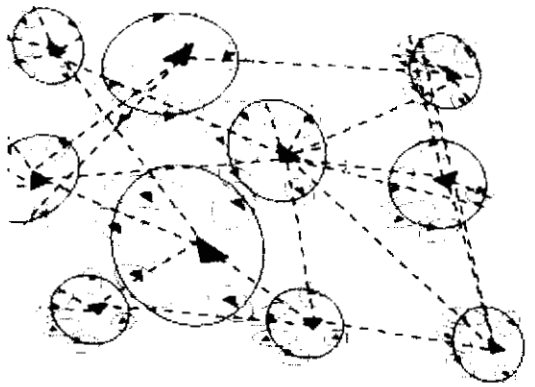
Snapshot of a Generic RDC Network



- **The inter-RDC networks creates an integrated backbone**

Legend: ▲ LPC/DPC ● 3-Digit ZIP Code ▼ RDC

3. Optimization & Simulation Models

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The END Modeling Approach

To achieve the objectives of END, we developed a modeling approach centered around two types of models:

What's Lowest Cost?

- **Optimization Models**
  - Used to identify the lowest cost network for a given distribution concept

What's Feasible?

- **Simulation Models**
  - Used to estimate the operational performance for specific network alternatives

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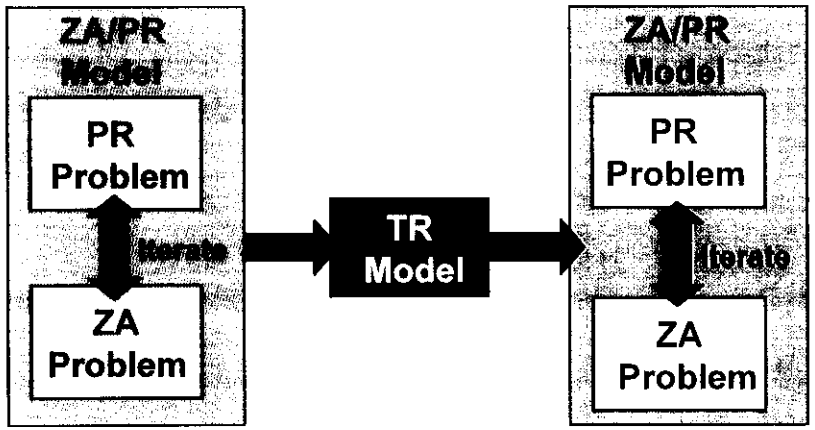
Optimization Modeling Approach

- **Three different problems needed to be solved**
  - ZIP Assignment Problem: Determines which ZIP Codes should be handled at each plant for both originating and destinating mail
  - Processing Role Problem: Determines where mail should be concentrated for processing (i.e. where should mail be processed)
  - Transportation Problem: Determines if and where mail should be concentrated for transportation purposes (i.e. STC)



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Optimization Model

- **Utilized LogicNet Plus software**
  - Customized the software package to the complexity and uniqueness of the USPS network
- **Mixed Integer Programming model**
- **Objective function: Develop least cost solution for a particular distribution concept**

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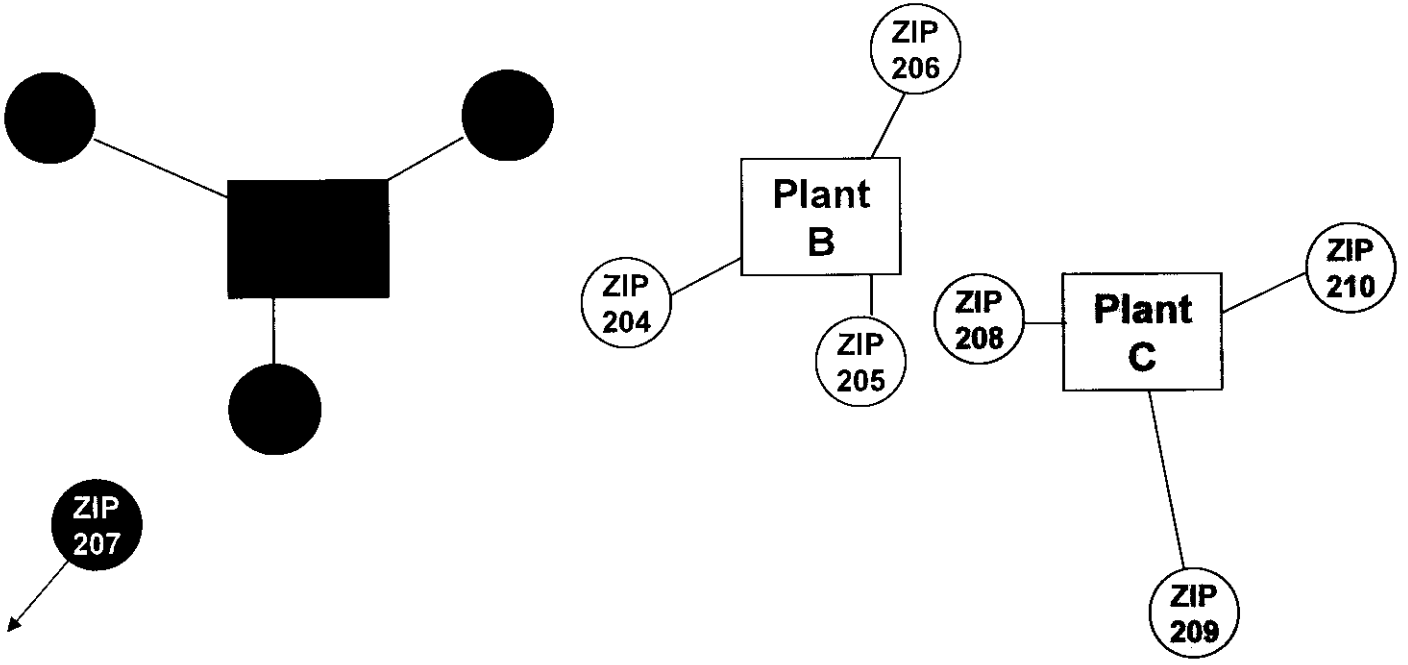
Example of How the Optimization Model Works

- Let's assume that Plants A, B, and C have the following ZIP Code Assignments in the baseline



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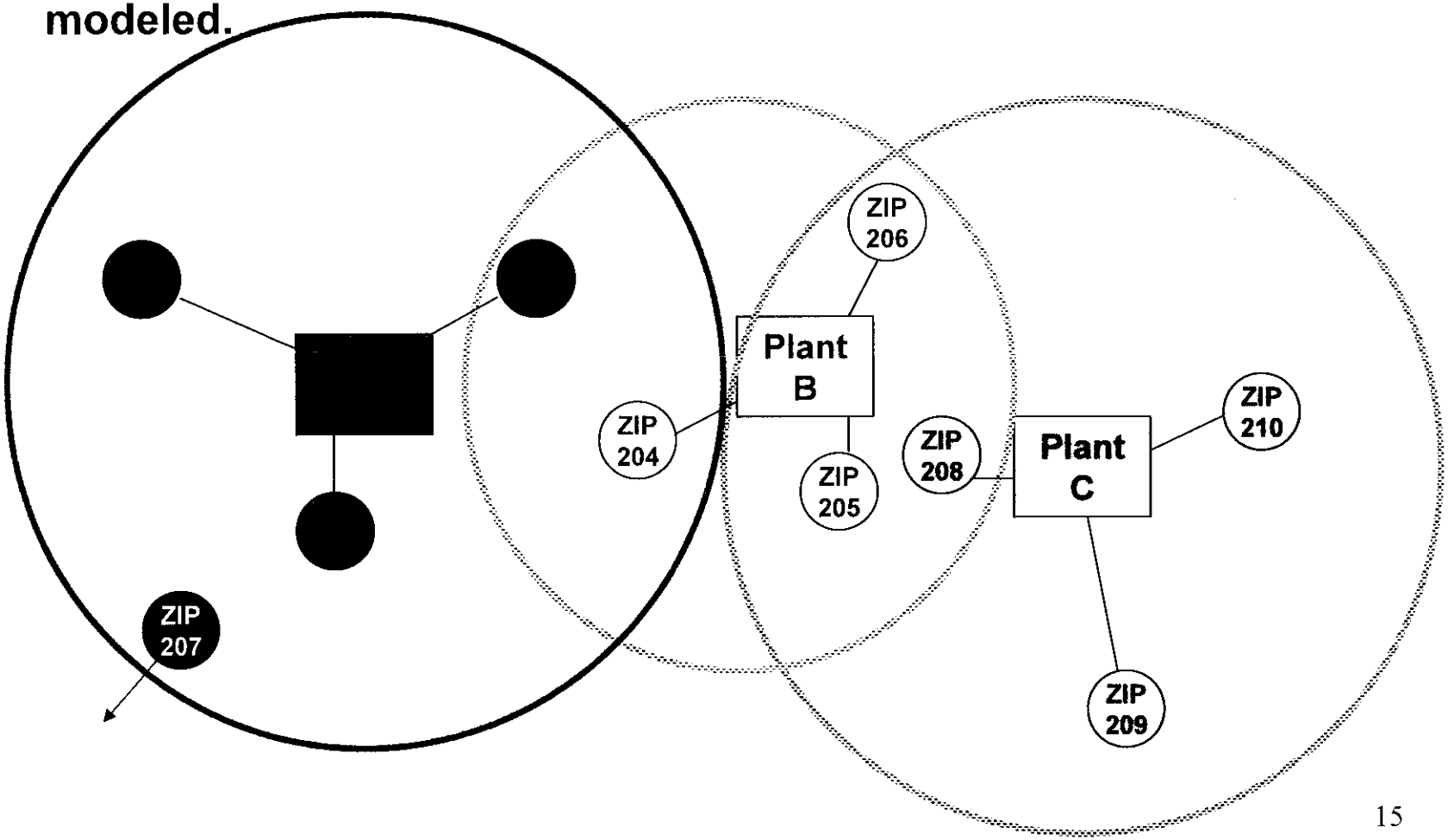
Example of How the Optimization Model Works

- Before the model considers reassigning ZIP Codes, all feasible ZIP Assignments are determined based on the distribution concept being modeled.



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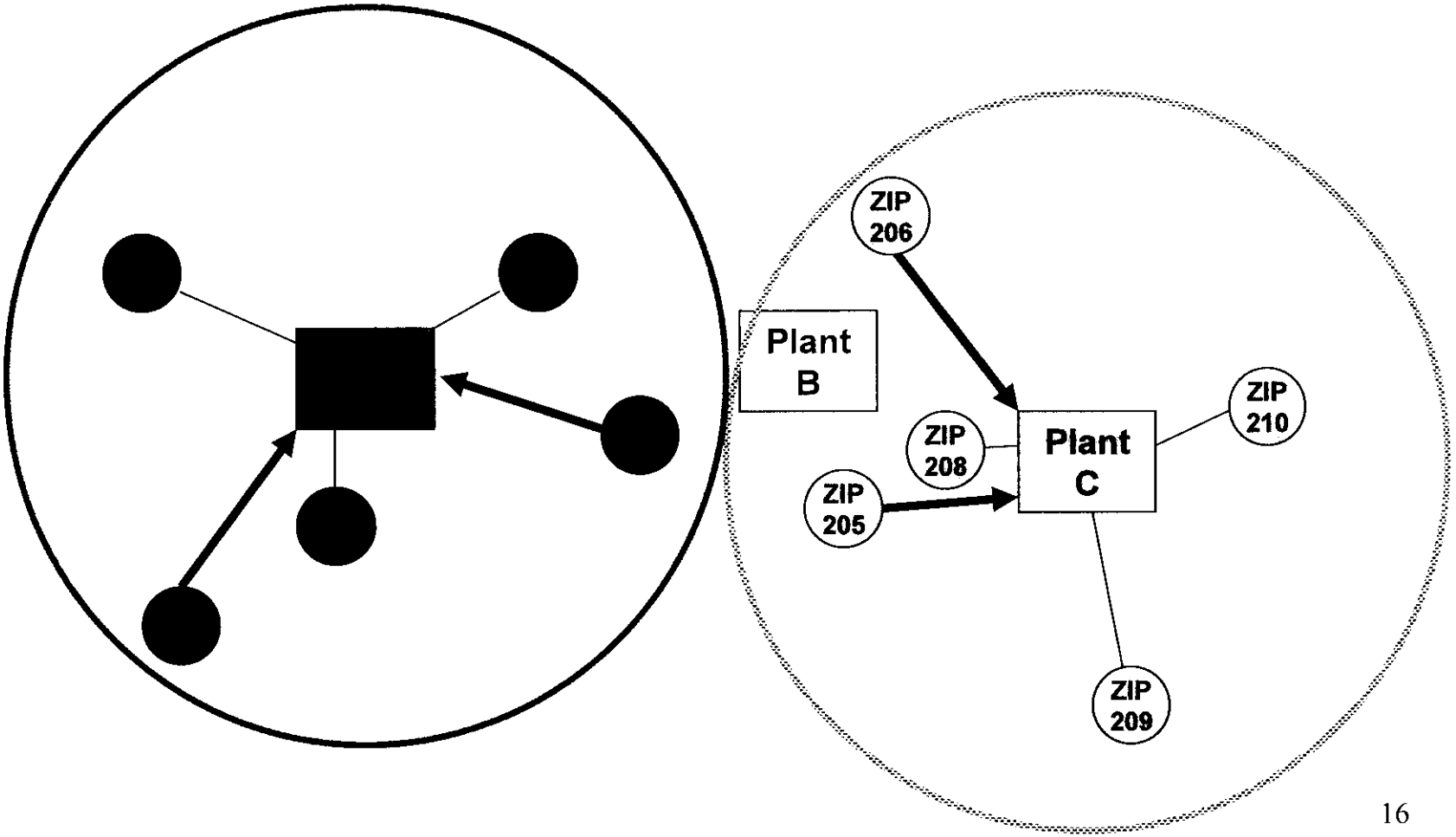
Example of How the Optimization Model Works

- The model will then reassign ZIP Codes within the feasible assignments to maximize utilization and minimize cost.



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Summary of Outputs

- **The primary output of each optimization model run includes:**
  - Processing and transportation cost
  - Selection of facilities and roles
  - Capacity requirements for each facility

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Appropriate Use of Modeling Techniques

- **Optimization**
  - Used to determine optimal balance of site locations, transport and warehouse costs, sourcing strategy, and transport planning
  - Model structure and algorithms are predefined, allowing rapid modeling
  - Large networks can be analyzed quickly
  - Does not handle timing and synchronization issues in detail
- **Simulation**
  - Predict complex behavior
  - Time-dependent
  - Evaluate variability
  - Each item simulated is time-and-place traced in the model
  - Synchronization, timing and integration
  - Does not find a solution
  - Large networks are very difficult to model and take time

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Simulation Model

- **Utilized Rockwell Software's Arena simulation engine**
  - Re-designed a pre-existing postal simulation tool that was built for several European postal administrations and Canada Post
- **Discrete event simulator**
  - Entity based
  - Allows for detailing modeling of specific postal operations
- **The objective is to test the feasibility of the solutions suggested by the optimization model using more facility specific data.**
  - Feasibility is measured based on:
    - Operational performance
    - Resource utilization

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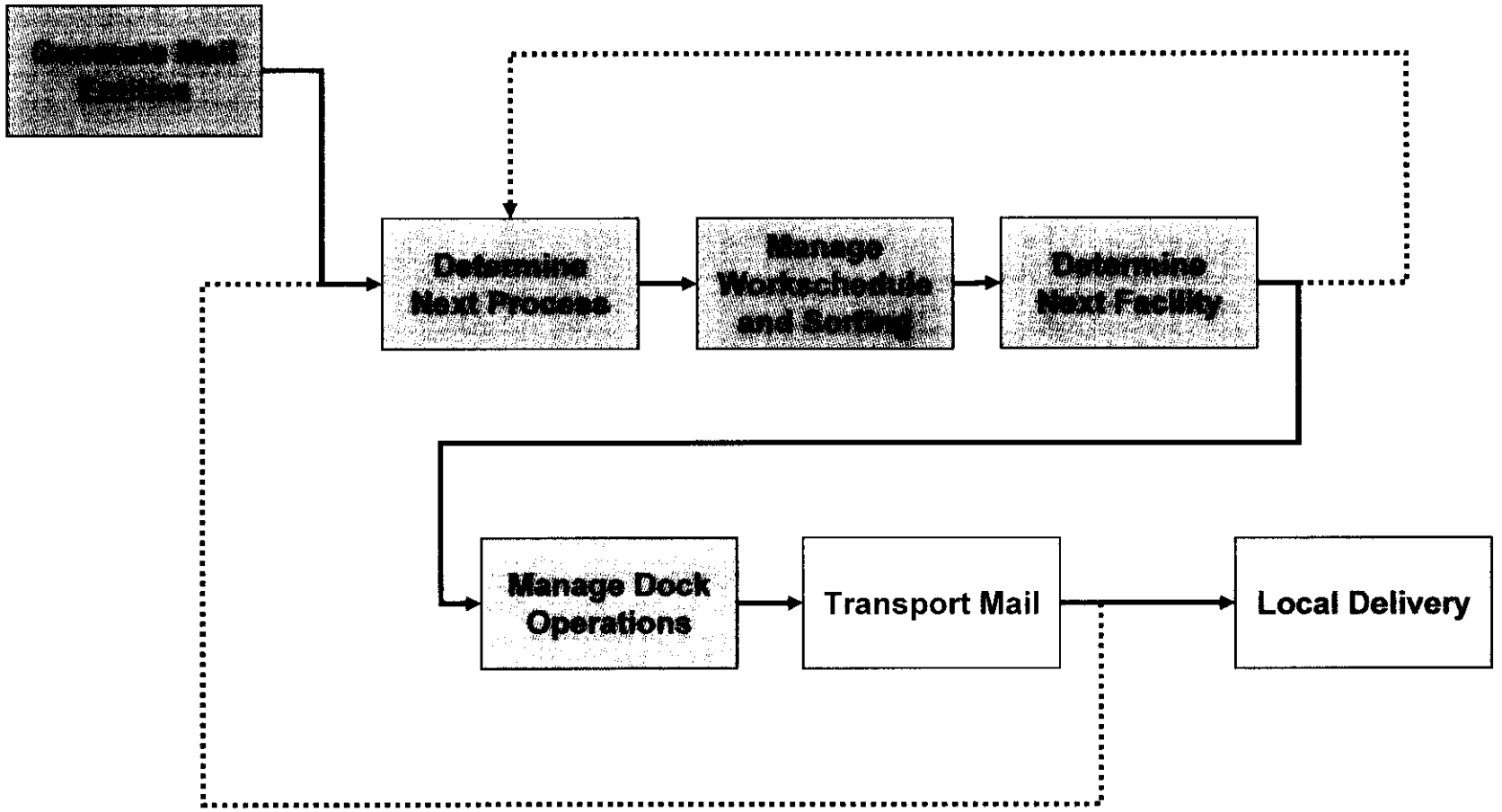
Regional Simulator – Modeling Decision Making Flow



Dotted lines- dependent on sort scheme

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Summary of Outputs

- **The primary output of the simulation model includes:**
  - Resource Utilization
  - Operational Performance
  - Transportation Statistics

4. Data Requirements

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4a. Facility Data

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Facility Data

- **The scope of END is limited to only those facilities with Function 1 workload.**
- The primary facility data elements focus on **Location** and **Processing Square Footage**.

Location

- Facility Name
- Address
- City, State, ZIP + 4
- Area
- Cluster
- Time zone

Processing Sq. Ft.

- Total Sq. Ft.
- Domestic Workroom Sq. Ft.
- Platform Sq. Ft.

4b. ZIP Code Assignments

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Definition of ZIP Assignments

- **END models require two inputs with respect to ZIP assignments:**
  - **Facility Assignments** –
    - 3-digit ZIP Code to processing facility
  - **Concentrator/Disperser Assignments** –
    - Origin processing facility to origin concentrator and destination disperser to destination processing facility assignments

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4c. Volume

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Definition of Volume Data

- **Volume**
  - Definition:
    - Total individual mail pieces entered into the mail stream during the specified time frame
  - Characteristics:
    - Scaled to match RPW volume totals
    - Identifies destination entry volume and level (DBMC, DSCF, or DDU)
    - Does not account for multiple handlings throughout the network
  - Example of the Data:
    - Number of mail pieces of a given product sent from an Origin 3-Digit ZIP Code to a Destination 3-Digit ZIP Code

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Sources for Volume Data

- **RPW volume**
  - Provides the national total volumes by class and subclass
  - RPW by Shape Report is used to further divide class and subclass volumes into shape and destination entry categories.
- **ODIS volume**
  - Provides origin-destination data for 3-digit ZIP Code pairs
- **DSAS appointments**
  - Provides the number of truck appointments
  - Serves as a proxy for drop-shipment volume
- **Permit volume from the PostalOne! System**
  - Provides origin 3-digit ZIP Code information

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4d. Workload

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Definition of Workload Data

- **Workload**
  - Definition:
    - Total number of handlings in the network during the specified time frame
  - Characteristics:
    - Derived from MODS and EOR data
    - Implicitly accounts for presort levels
    - Addresses multiple handlings, refeeds, and downflows
  - Example of the Data:
    - Number of handlings required for the volume at a facility on a piece of equipment (AFCS, DBCS, etc.) performing a specific operation (Cancellation, Outgoing Primary, etc.)

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Sources of Workload Data

- **EOR**
  - Function 1 automated letter and flat workload
- **MODS**
  - Function 1 manual letter and flat workload
  - Function 1 Priority Mail, parcel and bundle workload

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Uses of Workload Data

- **Optimization**
  - Estimate required mail processing capacity
  - Identify mail processing locations and roles
  - Estimate mail processing costs
- **Simulation**
  - Estimate required mail processing capacity

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4e. Capacity

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Capacity Methodology

Available Sq. Ft. in Plant **>=** **Sq. Ft. Needed for Volume in Plant**

- How do we calculate available square feet for each plant?

Total Facility Sq. Ft.
(minus) Non-Workroom Sq. Ft.
Total Workroom Sq. Ft
(minus) Non-Usable Workroom Sq. Ft.
Total Available Sq. Ft.

- Data based on survey of each site

- How do we calculate the square feet needed in a plant?
  - Sum the sq. ft. associated with each ZIP code assigned to a plant by the model

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4f. Mail Processing Costs

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The Role of Costs in the Model

- **Processing cost functions:**
  - Embody the economies of scale in variable costs
  - Include the fixed costs associated establishing operations and maintaining facility infrastructure
- **Transportation cost functions:**
  - Capture the change in transportation costs associated with network consolidations

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Development of the Cost Model

- **Objective:**
  - Develop shape-based cost functions that predict how costs will change under different facility configurations
  - Create a framework that is able to model the cost implications of:
    - Different volume levels by shape/product
    - Consolidation of operations by shape/product
- **Methodology:**
  - Mirror the existing product cost methodology used by Finance for production of the CRA
  - Develop linear cost functions that fit the Optimization model construct

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Role of Processing Cost Functions

- **Processing Cost Functions must make the following transition:**

Actual USPS Cost Generation		OR Model Cost Functions
• Operational Reality • Non-linearity • Existing Mail Flows	⇒	• Mathematical Tractability • Linearity • Product/shape based

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Direct Cost Functions Determined by Size

- Direct cost functions are developed for small, medium, and large operations for each shape
- Size breaks are operation-specific
- Match actual productivities in small, medium, and large operations

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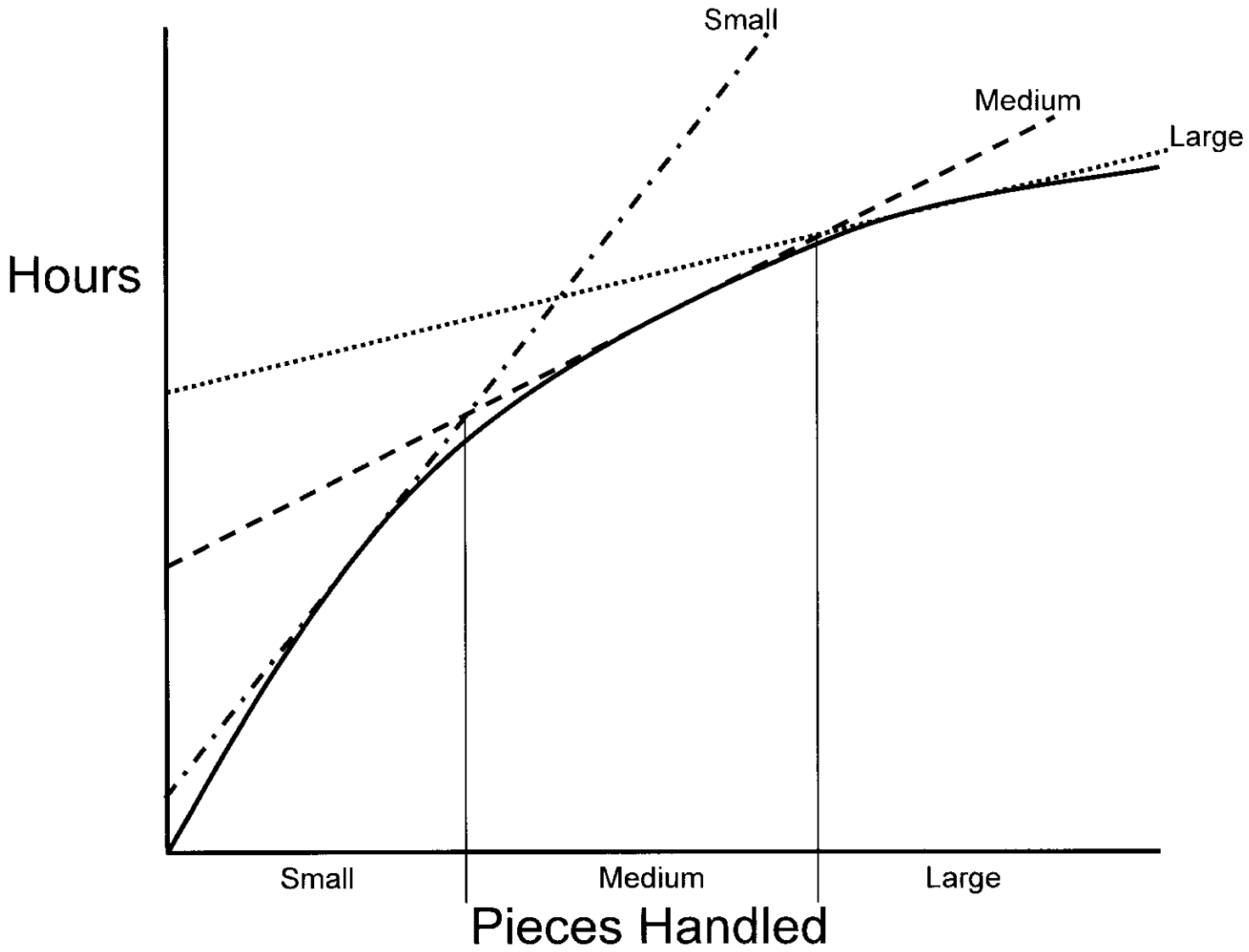
Using Size to Capture Non-Linearity



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4g. Transportation Costs

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Transportation Cost

- **The model calculates transportation requirements based on annual volume**
- **Surface Transportation**
  - All surface costs are based on national average HCR rates divided into five mileage bands
  - Within each mileage band, we calculated an average cost per mile
- **Air Transportation**
  - Use negotiated contract costs for all air transportation carriers